

Indoor air quality, thermal comfort and daylight policies on the way to nZEB

Status of selected MS and future policy recommendations

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Agenda

1. Introduction

2. Indoor air quality

- ✓ Ventilation rates, airtightness, indoor pollutants, heat recovery, mechanical and natural ventilation

3. Thermal comfort

- ✓ Minimal & maximal temperature, air velocity, humidity, requirements for exterior building elements

4. Daylight requirements

5. Compliance and control

6. Recommendations

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Introduction

The EPBD (2010/31/EU)

Article 4 - Setting of minimum energy performance requirements

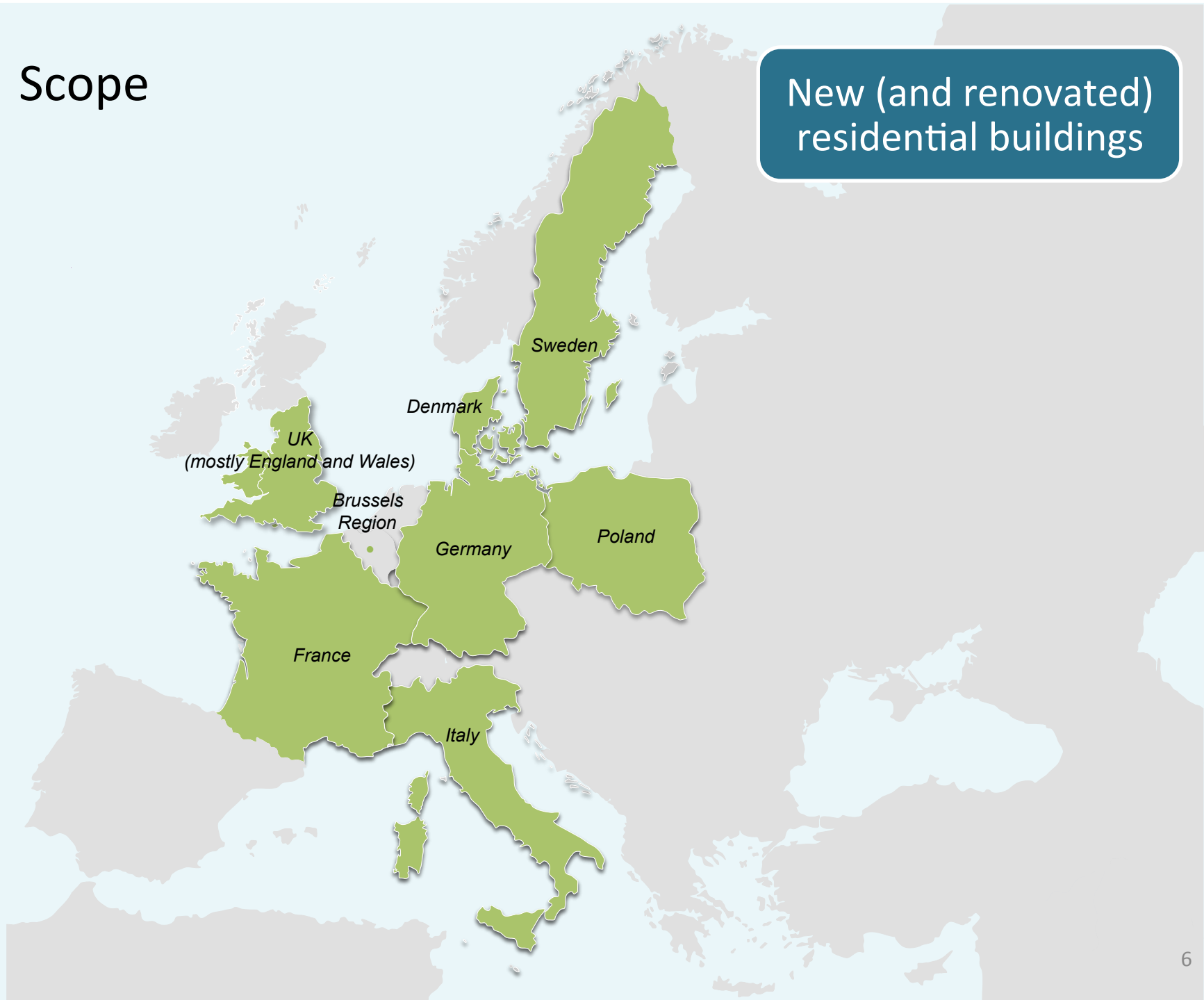
- Minimum energy performance requirements “**shall take account of general indoor climate conditions**, in order to avoid possible negative effects such as inadequate ventilation”

Article 9 – Nearly zero-energy buildings

- By 31 December 2020, all new buildings are nearly zero- energy buildings
- The national plans shall include:
 - nZEB definition
 - intermediate targets or improving the energy performance of new buildings
 - information on policies and financial measures ... concerning the use of energy from renewable sources.

Scope

New (and renovated)
residential buildings



“Indoor Air Quality is the environmental characteristics inside buildings that may affect human health, comfort or work performance”

❖ Indoor air quality

In urban areas, 60-90% of people's life is spent in buildings

In 2012, 99 000 deaths in Europe and 19 000 in non-European high income countries were attributable to household (indoor) air pollution

Indoor air pollution can be 2-5 times higher than in outside air

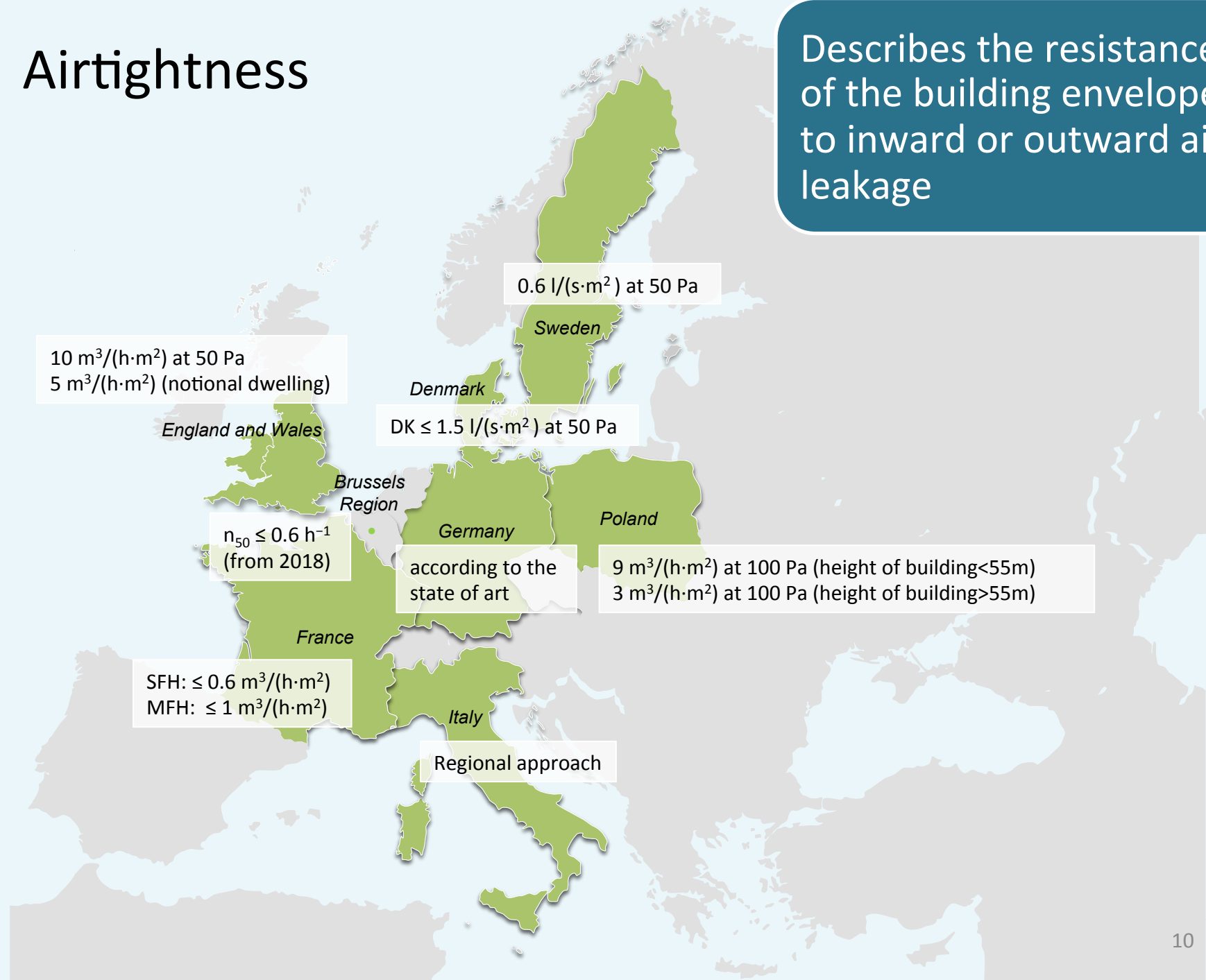
Economic dimension of increased IAQ: productivity & health aspects

❖ IAQ in new buildings - Main findings

- All analysed MS have at least a basic reference to IAQ included in their Building Codes.
- Ventilation rates: Some regulations consider the overall ventilation rate in the building; others the minimum supply air per type of room.
- Airtightness requirements differ largely over Europe: 6 MS have precise values in place; Germany generally requires a state of the art level of airtightness and Italy follows a regional approach.
- Mandatory mechanical ventilation is required in some cases in DK and in PL, for all other cases recommendations vary from rather pro mechanical ventilation (Brussels, DE) or neutral position (DK, FR, SE, UK) to pro natural ventilation (IT).
- Requirements on heat recovery are rarely found in national building codes for dwellings. Mandatory only in Denmark and Sweden.

Airtightness

Describes the resistance of the building envelope to inward or outward air leakage



Ventilation rates

The indicators for minimum ventilation rates vary from one country to another and are generally different from the EU standards

Country and Standard Reference	Whole Building Ventilation Rates	Living Room	Bedroom	Kitchen	Bathroom + WC	WC only
Brussels (NBN D 50-001)	3.6 m ³ /(h·m ²) floor surface area	Minimum 75 m ³ /h (limited to 150 m ³ /h)	Minimum 25 m ³ /h (limited to 72m ³ /h)	Open kitchen Minimum 75 m ³ /h (exhaust)	Minimum 50 m ³ /hour (limited to 75 m ³ /h)	Minimum 25 m ³ /h
Denmark (BR10)	Min. 0.3 l/s/m ² (supply)	Min. 0.3 l/s/m ² (supply)		20 l/s (exhaust)	15 l/s (exhaust)	10 l/s (exhaust)
France (Arrêté 24.03.82)	10-135 m ³ /h (1-7 rooms, depending on room number and ventilation system)			Continuous: 20 – 45 m ³ /h		Minimum: 15 m ³ /h
Germany (DIN 1946-6)	15-285 m ³ /h (basic ventilation for 30m ² – intensive ventilation for 210m ²)			45m ³ /h (nominal exhaust flow)	45 m ³ /h (nominal exhaust flow)	25 m ³ /h (nominal exhaust flow)
Italy (Legislative Decree 192/2005, Uni EN 15251)	Naturally ventilated: 0.3 – 0.6 vol/h	0.011 m ³ /s per person for an occupancy level of 0.04 persons/m ²			4 vol/h	
Poland (Art 149 (1) – Journal of Laws 2002 No. 75, item. 690, as amended and PN-B-03430:1983/Az3:2000)	20 m ³ /h for each permanent occupant (calculated according to the Polish standard but not less than 20 m ³ /h)	20 -30 m ³ /h for each permanent occupant (for public buildings) For flats it is summary of flow from all rooms		30 m ³ /h to 70 m ³ /h without windows	50 m ³ /h	30 m ³ /h
Sweden (BFS2014:13 – BBR21)	Supply: min 0.35 l/(s·m ²) floor area					
UK (Approved Document F)	13-29 l/s (depending on bedrooms)			13-60 l/s (extract)	8-15 l/s (extract)	6 l/s (extract) 11
EN 15251	0.35 – 0.49 l/(s·m ²)	0.6 – 1.4 l/(s·m ²)		14 -28 l/s	10- 20 l/s	7-14 l/s

“*Thermal comfort*” that condition of mind which expresses satisfaction with the thermal environment”

❖ Thermal Comfort

Between 30% and 50% of excess winter deaths can be attributable to cold indoor temperatures.

Excess heat negatively affects the health of people suffering from cardiovascular diseases, diabetes, Parkinson's, Alzheimer's and epilepsy.

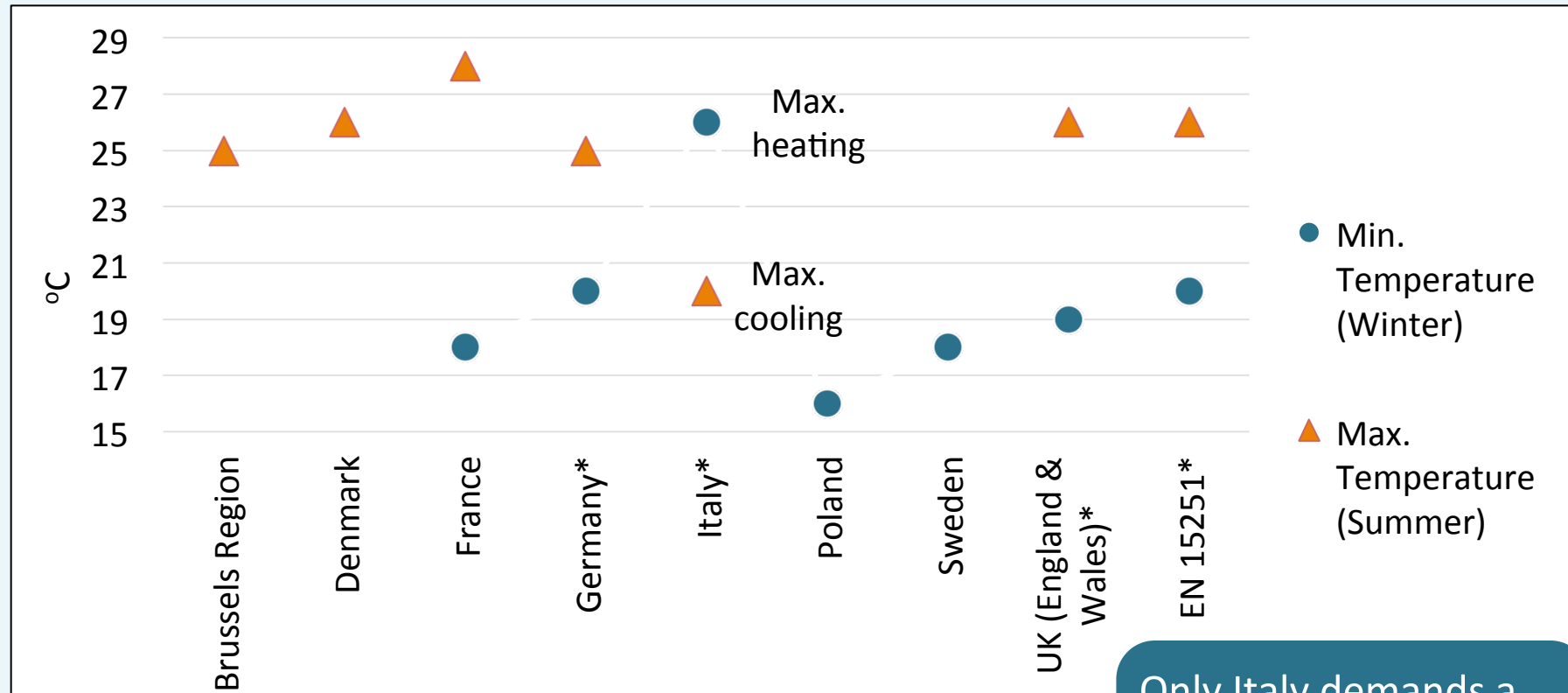
Excess cold and mould in homes lead to asthma/respiratory illness and affects negatively the mental health of the occupants.

Children's educational attainment and emotional wellbeing can be affected by thermal discomfort.

❖ Thermal Comfort in new buildings - Main findings

- The most commonly used indicator of thermal comfort is the indoor air temperature, where requirements/recommendations range between 16°C (Poland, winter case, lower limit) and 28°C (France, summer case, upper limit).
- Brussels Region (>25°C for 5%/yr) , Denmark, France, Germany and the UK (>28°C for 1%/yr) have introduced in their buildings codes limitations of overheating, where overheating indicators differ by temperature and time limit.
- Maximum relative air velocity limits range from 0.15 to 0.40 m/s (in summer) and from 0.15 to 0.21 m/s (in winter).
- Recommendations concerning the humidity are given in Germany, Poland, Italy, Sweden and the UK.
- All studied countries introduced minimum requirements for thermal transmittance of external building elements as a matter of energy saving.

Minimal and maximal temperature requirements



Only Italy demands a lower limit in summer and upper limit in winter.

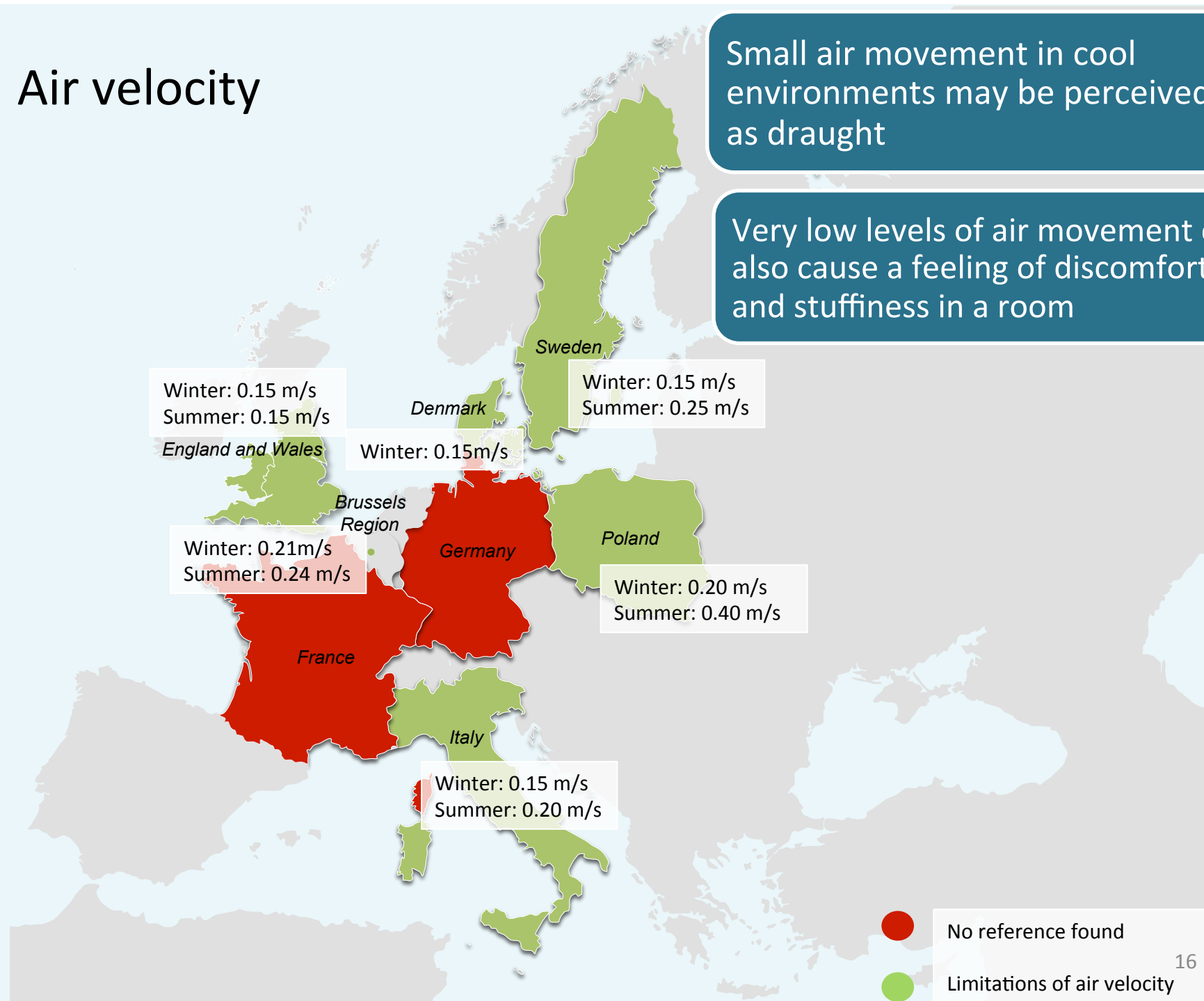
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Germany: up to 27°C in summer, depending on the regions (from 25°C to 27°C)
Italy: heating and cooling limits to reduce energy consumption (no thermal comfort indicator)
Sweden: values vary depending on occupant group
UK: values vary depending on the room use
EN 15251: recommended design values

Air velocity

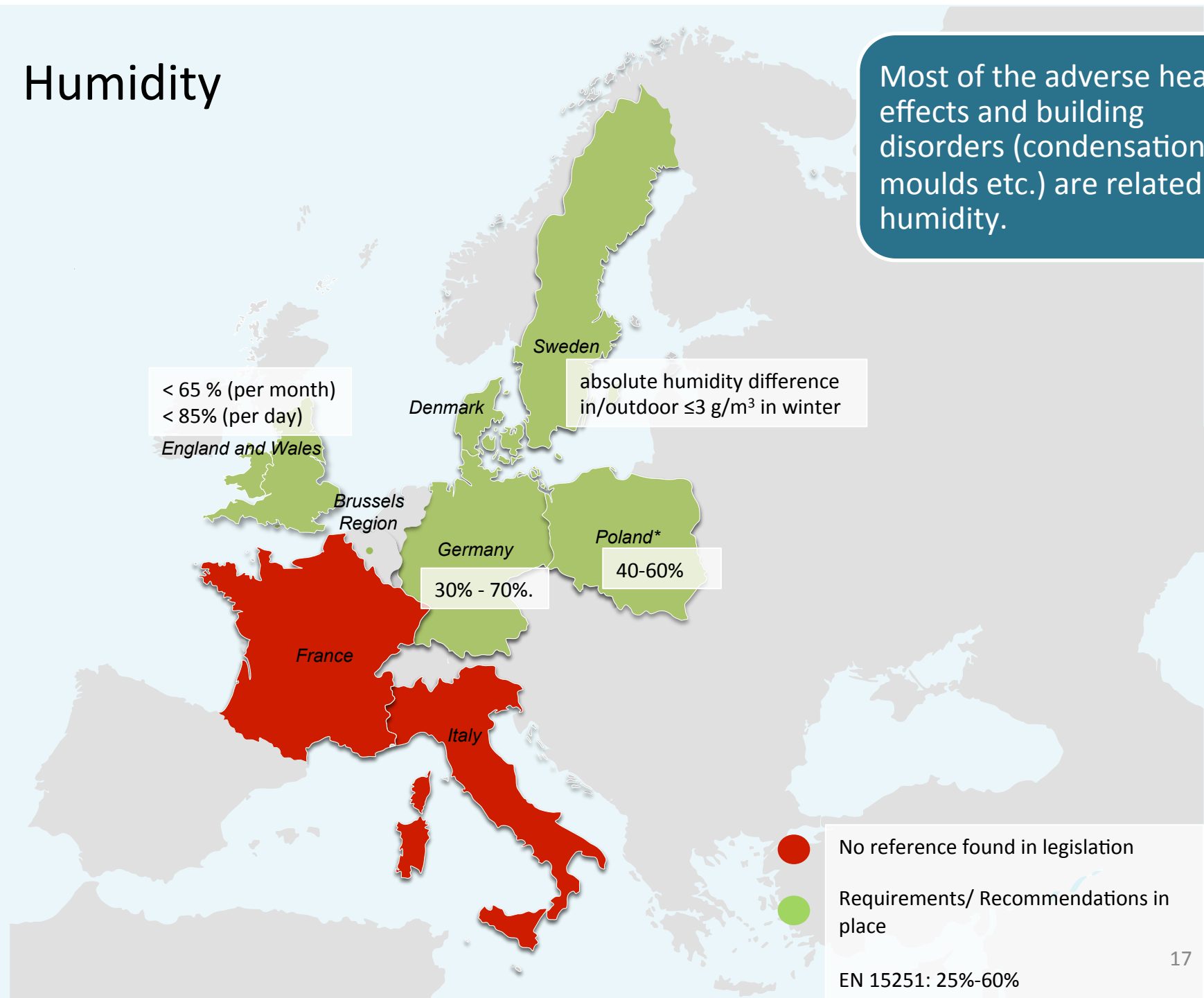
Small air movement in cool environments may be perceived as draught

Very low levels of air movement can also cause a feeling of discomfort and stuffiness in a room



Humidity

Most of the adverse health effects and building disorders (condensation, moulds etc.) are related to humidity.



Daylight requirements in residential buildings

❖ Daylight requirements

63% of the people rated natural light as the most important aspect of a home (survey: homewise, without space+light)

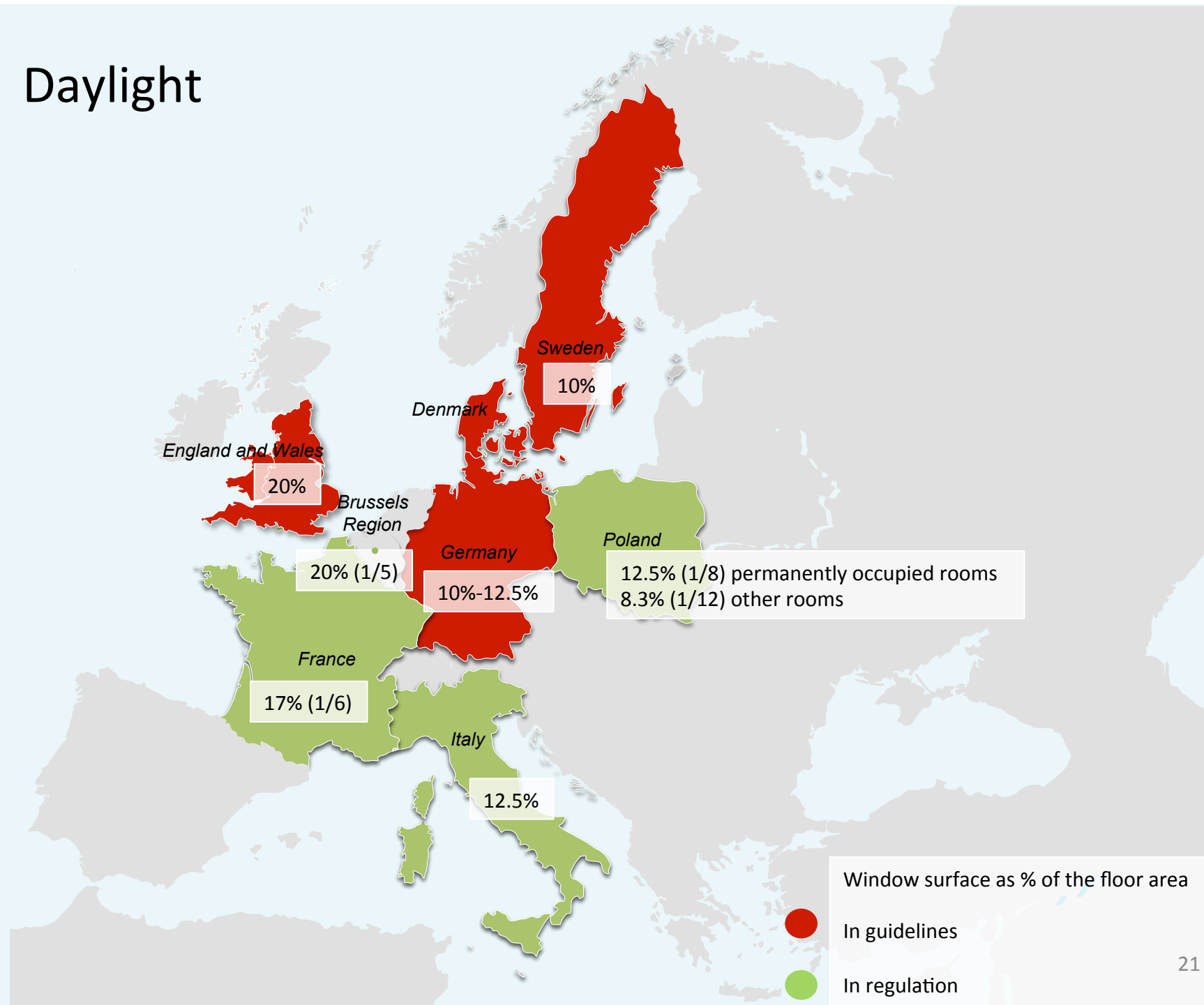
Daylight improves visual and psychological comfort, and has a positive effect on people's performance, attentiveness, satisfaction and capacity to learn

Daylight alleviates Seasonal Affective Disorder (form of depression)

❖ Daylight requirements in new buildings – Main findings

- All countries include at least a basic reference to daylight in their building codes.
- Daylighting requirements or recommendations in legislation mainly:
 - specify a minimum share of window/glazing area per floor area
 - indicate minimum levels of daylight
 - stipulate the need for sunlight access in buildings and for a view to the outside
- Swedish law is unique as it recommends the use of daylight management systems for permanently installed luminaries.
- Only some building codes (Brussels, Denmark, Germany) highlight the importance of having a view to the outside as an important part of visual comfort.
- In England and Wales, the **Right to Light** is protected by law (Prescription Act 1832): if a new building limits the amount of light coming in through a window the owner is entitled to take legal action against the landowner if he considers that his light is being blocked.

Daylight



Compliance and control in residential buildings

❖ Compliance and control in residential buildings

- Compliance procedures are mainly focusing on structural analysis and energy performance aspects of new constructions, such as U-Values, right installation of heating equipment, airtightness, availability of EPCs, etc.
- Compliance with indoor air quality or thermal comfort standards is rarely checked by designated control bodies and if so, mainly at the design stage rather than by performing onsite measurements.

Recommendations

❖ Recommendations

- Indoor health and comfort aspects should be considered to a greater extent in European building codes than it is current practice.
- In EU and national legislation, stricter energy performance requirements should be completed with appropriate requirements and recommendations to secure proper indoor air quality, daylight and thermal comfort.
- Indoor air quality, thermal comfort and daylight indicators should be integrated in the EPCs as relevant information regarding the actual living conditions in the building.
- A proper cost indicator and calculation formula that estimate the benefits of a healthy indoor environment should be developed, considered and further integrated in the European methodology to calculate cost-optimal levels at macroeconomic level.
- Co-benefits of a healthy indoor environment should be taken into account when assessing the macroeconomic impact of energy renovation measures.

Thank you!

